AN EVALUATION OF DENTAL CROWDING IN RELATION TO THE MESIODISTAL CROWN WIDTHS AND ARCH DIMENSIONS

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INTRODUCTION:
The human mind as represented in Philosophy and Science nourishes a devouring passion for unification. The majority of the demands for orthodontic treatment arise because the teeth are a decorative component of face and the desire for teeth which give at least the appearance of perfection.

Crowded, irregular and protruding teeth have been a problem for some individuals since antiquity.

To study the prevalence of various occlusal relationships, two large scale surveys were carried out in United States and published in 1970s and it was found that crowded malaligned teeth are the most common single contributor to malocclusion.\(^1\)

Crowding of the teeth, can be defined as a disparity in the relationship between the tooth size and jaw size. Nance\(^2\) described dental crowding as the difference between the space needed in the dental arch and the space available in that arch that is - the space discrepancy.

The causes of crowding are however still not fully understood. Many etiologic possibilities have been stated for the crowding.

Abstract
The present study was carried out to examine the extent to which tooth size and jaw size each contribute to dental crowding. Two groups of dental casts were selected on the basis of crowding. One group exhibited gross dental crowding and the second group little or no crowding. Means and standard deviations of the following parameters were treated to statistical analysis.

1) Collective Mesiodistal tooth widths.
2) Arch perimeters.
3) Buccal arch widths.
4) Lingual arch widths.

Statistically there were no significant differences in the collective mesiodistal teeth dimensions but significant differences were found between the dental arch dimensions of the two groups. The crowded group was found to have smaller dental arch dimensions than the noncrowded group.

Key Words
Crowding, Mesiodistal width, Arch width, Arch perimeter.
Crowding undoubtedly is related to reduction in jaw and tooth size in human evolutionary development\(^{(13)}\). The Fossil record documents evolutionary trends over many thousands of years that affect the present dentition, including a decrease in the size of individual tooth, a decrease in number of teeth, and a decrease in the size of the jaws.

Hooten\(^{(8)}\) suggested that dental crowding may result from an evolutionary trend toward a reduced facial skeleton size without a corresponding reduction in tooth dimension.

Lundstrom\(^{(5)}\) stated that tooth size increases as crowding increases. He also stated that arch perimeter decreases as crowding increases in an examination of the variation of tooth size as the etiology of malocclusion. Lundstrom\(^{(8)}\) stated that persons with large teeth are likely to have crowding than those with small teeth.

Brash\(^{(7)}\) said that crowding was hereditary and may result from continued interbreeding between physically dissimilar ethnic groups. He stressed environmental factors reasoning that the modern, refined diet must have played a role in reducing muscular stimulation hence the full expression of facial growth.

Barber\(^{(8)}\) speculated that dental crowding may result from abnormal muscle forces, abnormal paths of tooth eruption, occlusal forces resulting in mesial migration of the teeth and loss of arch length through dental caries.

Egil P. Harvold\(^{(9)}\) said that functional deviations either metabolic or neuromuscular are responsible for the various malocclusions. With, the respect to spacing and crowding of teeth function and posture of tongue are dominant in the mandibular arch than maxillary arch.

Sex differences in crowding have been reported by Lavelle \(^{(10)}\).

Edward F. Harris et al \(^{(11)}\) concluded that arch size, arch shape and occlusal relations indicate a dominance of environmental over genetic factor.

How R. P. McNamara JA, O’ Connar KA\(^{(12)}\) carried out an investigation to examine the extent to which tooth size and jaw size each contribute to dental crowding. The crowded group was found to have smaller dental arch dimensions than noncrowded group.

Mills\(^{(13)}\) Mckeeown\(^{(14)}\) found more correlation between arch size and dental crowding than between tooth size and dental crowding.

D. Radznic\(^{(15)}\) carried out a investigation to determine the correlation among cumulative mesiodistal crown widths, arch dimensions and the degree of primary dental arch crowding. Two different ethnic groups were studied namely Indigenous British and Pakistani immigrant. The results showed that in both ethnic groups there were very significant co-relations between cumulative mesiodistal crown widths and dental crowding when considered in isolation.

Carl Magnus Forsberg\(^{(16)}\) also found that the arch dimensions were important factors for crowding than the tooth dimensions.

Jorge Fastlicht\(^{(17)}\) carried out a study to classify the causes of malocclusion in anterior teeth and concluded that mesiodistal width was directly related to crowding and was more in males in mandibular incisor region.

Barry F. Wood\(^{(18)}\) stated that lack of proper nutrition coupled with early loss of deciduous teeth could well account for the high percentage of anterior crowding and cross bites more in girls than boys. There was little difference between males and females with respect to intercanine and intermolar measurements in normal and malocclusion.

Peck and Peck \(^{(19, 20, 21)}\) presented a data which indicated that the presence or absence of lower incisor crowding was related to the shape of lower anterior teeth. Persons with ideal incisor alignment were shown to have incisors with smaller mesiodistal and larger labiolingual dimensions than persons with incisor crowding.

John M. Doris\(^{(22)}\) et al concluded that the arches with crowded teeth have larger teeth than the well aligned teeth.

John Mew\(^{(23)}\) stated that the causes of malocclusion can be considered under three headings congenital failures, inherited deficiencies and environmental factors.

A Vincent Lombardio\(^{(24)}\) stated that dental crowding is endemic among technologically advanced populations than primitive groups.

The present study was carried out to determine the correlation among the mesiodistal crown widths and arch dimensions. Dental casts of two groups of subjects, one with well aligned dental arches and one with significant crowding were compared. Attempts were made to study if there are significant differences in mediodistal crown widths collectively and arch dimensions in the crowded and noncrowded dental arches.

**MATERIALS AND METHODS :**

With the view to study dental crowding and its relationship to mesiodistal crown dimensions and arch dimensions - maxillary and mandibular casts of 98 Indian subjects were used between age group 13 to 21 years. During selection the following criteria were applied.
i) All the permanent teeth with or without third molars in either arch are present.

ii) All the permanent teeth are in a sufficient state of eruption to permit measurement of the mesiodistal crown dimensions.

iii) No previous Orthodontic treatment involving the deciduous, mixed or permanent dentitions in either arch.

iv) No large coronal restorations that might have altered both coronal shape and size.

v) Models undamaged in areas of measurement. Besides this, selection procedure was intentionally carried out to select two groups.

In the first group maxillary and mandibular casts of 46 subjects (22 boys and 24 girls) were selected from the schools and a college in the vicinity after examining 1602 subjects.

The following criteria were applied during selection of the subjects for this group.

i) Dental arches with well aligned teeth. (fig. 1)

ii) Angle’s Class I molar relation. (fig. 2 & 3)

iii) Angles Class I canine relation (fig. 2 & 3)

iv) Esthetically pleasant profile. (fig. 4)

v) Maximum overbite 2 to 3 mm. (fig. 5)

vi) Maximum over jet 2 to 3 mm. (fig. 5)

vii) Slight rotations & mid line deviations were accepted.

Figure 1

[Image of dental casts representing statistical averages for the noncrowded group]

Figure 2

[Image of left lateral view of the same occlusion]

Figure 3

[Image of right lateral view of the same occlusion]

Figure 4

[Image of profile of the study object for the noncrowded group]
In the second group maxillary and mandibular casts of 52 subjects (28 boys and 24 girls) were selected after examining 1106 subjects from the outpatient department of Orthodontics of the Government Dental College and Hospital, Mumbai -1, India on the basis of gross crowding. (fig.6)

Upper and lower arch impressions were made in alginate impression material and were poured with dental stone plaster. The measurements were done directly on the casts.

Both the maxillary and mandibular casts of each subject were cross checked by two orthodontic consultants and the casts chosen were those about whom the consultants were of opinion that the above mentioned criteria were fulfilled.

METHODS:

Mesiodistal crown widths: Individual mesiodistal crown widths of all permanent teeth exclusive of second and third molars were measured at the contact points with a Vernier gauge to nearest 0.1 mm with the blades of calipers perpendicular to the long axis of the tooth as advocated by Hunter ws and priest WR.26 (fig.7)

Measurements were made separately for right and left sides, separately for males and females.

The cumulative mesiodistal crown widths were calculated as the sum of mesiodistal crown widths on right and left sides up to first permanent molar.

ARCH WIDTH:

Lingual and buccal arch width: Measurements were recorded with vernier caliper nearest 0.1 mm for
i) first permanent molar region
ii) canine region

Lingual arch widths were measured at the cervical region of each designated tooth from midpoint of the lingual surface of the tooth to corresponding point on its antemere.(fig.8)

Buccal arch widths were measured from a point on the buccal gingiva 5 mm apical to the mesiodistal center of each tooth to a corresponding point across the dental arch12 as advocated by Howe RP, McNamara JA, O Connor (fig. 9 & 10)

ARCH PERIMETER:

Arch perimeter was measured by the method advocated by William Proffit13 over the contact points of posterior teeth and incisal edges of anteriors, by dividing the
dental arch into segments that can be measured as straight line approximations of the arch from distal surface of first permanent molar to distal surface of opposite molar (fig. 11)

RESULTS:
Overall no significant differences were found in teeth sizes between the noncrowded and crowded groups when sums of entire arches upto first permanent molars were compared. Significant differences were observed when the arch dimensions as lingual arch widths, buccal arch widths, dental arch perimeters were compared.

TOOTH SIZE:
The difference in the mean values of sums of mesiodistal-teeth widths between crowded and noncrowded groups for males was 1.42 &1.44 and for females 1.37 & 1.38 in maxillary & mandibular arches respectively. These differences were not statistically significant. (Table I & II)

ARCH DIMENSIONS:
Arch Perimeter: Arch perimeter was greater in noncrowded arches both in males and females and was statistically significant. (Table III & IV)
Arch widths: Both buccal and lingual arch widths were greater in non-crowded arches in males and females than the crowded arches and the differences were statistically significant. (Table V, VI, VII & VIII)

Tables showing
Statistical analysis done by “t” test
where
NC- Non crowded group C - crowded group
N - Number of subject All measurements in mms.
S.D.- Standard deviation P.- Statistical significance
NS - Not Significant P. - < 0.01 Statistically Significant

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<thead>
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<th>Table No. I</th>
<th>STATISTICAL ANALYSIS OF TOOTH SIZE - MESIODISTAL SUMS OF TEETH IN MALES</th>
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<td>Group</td>
<td>N</td>
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<td>Maxillary Arch</td>
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<td>Mandibular Arch</td>
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<th>Table No. III</th>
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Table No. VII  STATISTICAL ANALYSIS OF
MANDIBULAR ARCH WIDTHS IN MALES

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<td></td>
<td>Canine</td>
<td>24</td>
<td>22.62</td>
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<td></td>
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<td>1.82</td>
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<td>4.89</td>
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DISCUSSION:
The finding of this study for the sample examined and methods used is that the subjects with dental crowding have smaller arch dimensions than those without crowding but there are no differences in collective mesiodistal teeth widths between the two groups.

The same results were previously reported by other authors. 

However the other authors found that individuals with large teeth are likely to have crowding than those with small teeth.

The differences in selection, number of sample size and methods used in various studies could be the reasons for dissimilar findings. Fastlicht study was to determine the influence of Orthodontic treatment on crowding of mandibular incisors and to examine the causes of mandibular crowding. Two groups of 28 subjects with equal sex distribution were compared, one group had subjects who had undergone Orthodontic treatment and the other group had no Orthodontic treatment. The basic differences in methods and findings of this study and the present study are 1) In the former study the subjects were grouped either treated Orthodontically or nontreated Orthodontically but in the present study the subjects were grouped on the basis of crowded arches and noncrowded arches. 2) In the former study sums of incisors were measured in contrast to the present study where mesiodistal sums of teeth distal to second molar were measured 3) In Fastlicht study one group i.e. untreated females had correlation between mesiodistal diameters of teeth and dental crowding. The other group i.e. untreated males had no significant relationship and two groups namely treated males and females were not reported. But in the present study all the four groups i.e. males and female with crowding and without crowding had no significant differences in mesiodistal diameters of teeth.

Nordeval found that subject with slight mandibular crowding had four lower incisors larger than the subjects without lower incisor crowding. Though the selection criteria was presence or absence of crowding the major differences were there. First in Nordeval’s study measurements were done only for lower incisors and not for all teeth mesial to second molar as in the present study and the subjects selected had slight anterior crowding in contrast to the present study where the subjects had gross crowding.

Efforts were made during the study to control the variables which could effect the results of the study.

The age range of the sample in this present study was 13 to 21 yrs. According to Doris et al this age group was ideal because of less mutilation and less attrition in most individuals so their effect on mesiodistal width was minimum.

Researches who studied growth changes in arch widths found intercanine and intermolar widths did not change after 13 yrs in females and 16 yrs in males so it was assumed that the widths in this group of sample were stable.

Sex differences in crowding have been reported. So the measurements were done separately for males and females.
The accuracy of measurements done by digital caliper on plaster casts made from alginate impressions were investigated in the past. Hunter and Priest\textsuperscript{29} indicated that there was considerable advantage in doing measurement on the cast than directly in mouth.

To establish consistency of recorded measurements a method described by Bishara\textsuperscript{33} etal was adopted. A Predetermined reliability was fixed at 0.2 m.m Double measurements were recorded for each parameter & discrepancies more than this limit were measured again and average of three nearest measurements were taken.

**CLINICAL IMPLICATION :**

The results of this study can be implied for clinical purpose. According to the present study Dental crowding is associated with small dental arches rather than large teeth, so greater considerations should be given to those treatment techniques which increase dental arch dimensions to accommodate the existing tooth mass.

Stress should be given on arch expansion than extraction of teeth to relieve the dental crowding. However, there are some limitations to this statement.

The decision of more expansion and its stability must be done on the basis of different factors.

Patients with v. shaped arch would have more potential for lateral expansion than oval arches.

The arch expansion unless accompanied by favourable growth pattern often leads to an imbalance between occlusal forces and soft tissue environment.

Age of the patient is also a critical factor as when the techniques of expansion are applied in non growing or adult patients will often lead to instability and relapse than in young and growing patients.

Rapid palatal expansion has long been a commonly used means for correcting maxillary transverse problems.\textsuperscript{39}

However, the various reports in the literature suggest that, rapid maxillary expansion has been used with a relatively high rate of success in the growing children.

Considering the indications and limitations of expansion it can be said that in some of cases extraction will continue to be an important treatment in the relief of crowding.

To increase the arch length it is relatively simple to move upper molars distally in growing patients using headgears in maxillary arch and lip bumpers in mandibular arch.\textsuperscript{30}

While applying the results of the study some limitations during the study should be considered.

The crown widths used in the study were mean values. However there can be individual tooth size variations in different ethnic or racial groups so generalizations can not be made and each arch must be assessed and treated individually.

The sampling procedure used in this study was not random but was intentionally based to produce two dissimilar groups. It should be remembered that the nonrandom selection procedure affected the result. So further investigation into the relationship of dental crowding to different ethnic and racial groups and with different sampling method may be productive.

**CONCLUSION :**

In conclusion it can be said that if the dental crowding is associated with small dental arches rather than large teeth greater considerations should be given to the treatment techniques which increase dental arch dimension especially in younger patients. Keeping the limitations of these techniques in mind one can say that in certain cases carefully planned extraction will continue to be a treatment to relieve the crowding.

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